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Cod Catch Results 2000: Year Four of the NAFO Subdivision 3Ps Fall GEAC Surveys.

Résultats de captures de morues de l'année 2000 : Quatrième année des relevés d'automne du GEAC dans la sous-division 3Ps de l'OPANO.

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Abstract

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys each fall from 1997 to 2000 directed at cod. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the fourth such GEAC survey in 3Ps following on the previous 1997-1999 surveys (CSAS Research Documents 99/20, 99/34, 2000/024). One trip to perform the 2000 survey was carried out from 4-15 December 2000. These dates correspond well with the late-November and December time periods for the earlier three years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging. Catch statistics, length and age distribution, and stratified analysis estimates of cod abundance and biomass, including age distribution estimates, and interpretation of results are presented.

Total abundance estimates for the 2000 survey are 37.7 million and up three-fold from 1998 and 1999 and comparable to those for 1997. Total biomass estimates for 2000 are 187 ktonnes and up almost four-fold from 1998 and 1999 and are almost double those of 1997. The results indicate that the 1997 year class stands out strong uniquely in 2000. The 1989 and 1990 year classes continue to be well-represented.

Résumé

Pour améliorer la base de données de recherche sur les pêches dans la sous-division 3Ps de l'OPANO, le Conseil des allocations aux entreprises d'exploitation du poisson de fond (GEAC) a financé des relevés de la morue effectués chaque automne de 1997 à 2000. Ces travaux ont pour but d'obtenir une série de relevés annuels automnaux dans 3Ps afin de compléter les activités d'évaluation de la ressource que mène actuellement le ministère des Pêches et des Océans (MPO). Le GEAC a financé et réalisé les relevés avec l'aide scientifique du MPO, qui a fourni des conseils scientifiques pour la conception et la réalisation d'un relevé aléatoire stratifié et des échantillonnages connexes. Les données ainsi recueillies ont ensuite été analysées pour le compte du GEAC et en vue de les transmettre au MPO pour qu'il les entre dans ses bases de données et s'en serve pour ses travaux d'évaluation. Il s'agit du quatrième relevé du genre effectué par le GEAC dans 3Ps, après ceux de 1997 à 1999 (documents de recherche du SCES 99/20, 99/34 et 2000/024). Pour réaliser le relevé de 2000, une sortie a été effectuée du 4 au 15 décembre 2000. Ces dates concordent bien avec les périodes de la fin novembre et de décembre au cours desquelles les sorties ont été effectuées les trois années précédentes. Pendant la sortie, les détails sur le mouillage des engins et les fréquences de longueur ont été enregistrés dans le système FFS du MPO, et des otolithes ont été prélevés pour déterminer l'âge des prises. Ce document présente des statistiques de captures, la distribution des longueurs et des âges, des estimations par analyse stratifiée de l'abondance et de la biomasse, notamment des estimations de la distribution par âge, ainsi que l'interprétation des résultats.

Dans le relevé de 2000, l'abondance totale a été estimée à 37,7 millions de poissons, soit un chiffre trois fois plus élevé qu'en 1998 et en 1999 et comparable à la valeur de 1997. En 2000, la biomasse totale a été estimée à 187 ktonnes, soit presque quatre fois plus qu'en 1998 et en 1999 et presque le double de la valeur de 1997. Les résultats montrent que la classe d'âge de 1997 ressort fortement en 2000 seulement et que celles de 1989 et de 1990 continuent d'être bien représentées.

Introduction

To enhance the fisheries research database in NAFO Subdivision 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys each fall from 1997 to 2000 directed at cod. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the fourth such GEAC survey in 3Ps following on the previous 1997-1999 surveys (CSAS Research Documents 99/20, 99/34, 2000/024 [1-3]). One trip to perform the 2000 survey was carried out from 4-15 December 2000. These dates correspond well with the late-November and December time periods for the earlier three years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging. Catch statistics, length and age distribution, and stratified analysis estimates of cod abundance and biomass, including age distribution estimates, and interpretation of results are presented.

Under contract to GEAC, AMEC has taken the data logged using the DFO FFS system, combined with the aged otiliths, created digital data files appropriate for inclusion in the DFO (VAX computer system) databases, and performed a first analysis of the survey results. This document presents these results.

Methods and Materials

A Stratified Random survey was carried out in 3Ps by the *M.V. Pennysmart*. A summary of the trip is presented below.

Trip 5: Stratified Random Survey

Trip 5 was carried out from 4 to 15 December 2000. This time period is consistent with the 1997-1999 stratified random survey sets. The *Pennysmart*, the same boat as in the previous surveys and with the same captain, sailed from Marystown for operation in 3Ps, St. Pierre Bank, Halibut Channel, and Green Bank. Figure 1 shows a map illustrating the location of the strata surveyed. The survey was directed at cod, American plaice, and witch flounder. Set details, length, sex, and otolith information were sampled. Approximately five days of survey time was lost due to poor weather and sea conditions. This had the impact of limiting the number of sets performed to 75, approximately 10 to 20 fewer than in the previous three years.

Tows of duration 30 minutes using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined) were conducted. The trawl was fitted with rock

hopper foot gear and Bergen #7 trawl doors. The 30 minute tows were commenced once the net reached the bottom.

Performance of the trawl was checked onboard using SCANMAR sensors: bridge display of doorspread and net opening (headline height) was visually monitored and these measurements together with trawl depth were noted every five minutes on the written bridge log for each set. The doorspread, opening, and clearance measurements were logged to computer disk using Seatrawl software. The trawl gear and configuration were identical to those used in the 1997-1999 surveys.

A total of 73 successful stratified random tow sets were completed. Two sets (#s 12 and 33) were unsuccessful: the net belly was torn and subsequently mended.

Data were logged using FFS with the length and otolith sampling carried out on board. The resulting ages were input to create an age and growth digital file.

Results and Discussion

Shore-based Analysis

The set details and cod length frequencies were exported from FFS to create ASCII data files. The age and growth data were keyed in following completion of the otolith aging by Norm Batten (otolith reader for 1997-1999 as well).

The cod were sampled in 1 cm length groupings and all ratio/percentages of catch measured were applied.

ACON plots of the spatial distribution of catch weights are presented in Figure 2 and include the corresponding catch results from the 1997-1999 surveys. Consistent with the earlier years, 2000 shows the greatest catch concentrations at the southern entrance to the Halibut Channel, and St. Pierre Bank: both southwest of St. Pierre and Miquelon near 46°N and in the southeastern reaches near Halibut Channel.

Table 1 presents a summary of the cod set details and catch numbers and weights. The mean cod catch for the 73 stratified random sets is 72 fish and a mean catch weight of 370 kg. A catch of cod was reported in 45 of the 73 successful sets. The largest catch of 3071 cod and weight 17083 kg was from set 45 in the Halibut Channel at a depth of approximately 220 m. This set 45 is the largest cod catch in the four years of surveys. The largest set catch previously was 8035 kg (1239 cod) from set 59 in 1998. Both of these sets are from stratum area 318. For 2000, a total of 12 sets had catches over 100 kg, four sets with catches over 1000 kg. The mean number of cod caught per set was 71.9 and the mean catch weight per set was 369.8 kg. The mean cod weight for all sets where cod was caught was 2.97 kg. The mean weight for the largest catch set 45 was 5.6 kg.

Gear Performance

The survey gear performance was monitored with SCANMAR units mounted on the net for doors, opening, and clearance measurement (Figure 3). The variability in the measurements is higher than is desirable and the net performance should be carefully monitored in the future. For the reported sets, doorspread exhibited a range of values from just under 40 m to just over 90 m. The mean doorspread values for 2000 are comparable to those measured with a NETMIND system used in 1999. The mean doorspread in 2000 was 72 m compared with 74 m in 1999. Net opening exhibits a mean of 5.4 m. The mean clearance was 0.6 m. While no wingspread sensor was present on the net for 2000, the vessel and gear are the same as previous years and there is nothing apparent in the 2000 SCANMAR measurements to suggest a drastic change in performance. Nevertheless, a more detailed comparison of net performance and mensuration should be undertaken in the future. For the present though, the assumption is made here to use the same 60 ft wingspread value for the stratified analysis that has also been used for the other years. This is appropriate for preserving the four year relative index of abundance.

Figure 4 presents the length composition of the 2000 survey and, for comparison, results from the 1997-1999 surveys are also shown. For 2000, the fish range in size between less than 40 cm up to 116 cm (two samples from sets 46 – the largest cod set, and 10 – the second largest set). The distribution shows a broad peak in the 70 to 90 cm range, similar in shape to that for 1997 and 1999 although the entire distribution in 2000 is shifted 15 to 20 cm to greater lengths. There is also a discernible secondary peak centred around 47 cm which extends from about 40 to 60 cm. The 2000 distribution is similar for the larger fish over 95 cm to that from 1998, the year which showed two well-defined length groups, one centred at 62 cm and one at 88 cm.

Conversely, while for 1998 there is a peak near 62-65 cm and extending between about 55 and 73 cm, the percent occurrence of those lengths are less than for 1997 and 1999. Between 40 and 50% of sampled cod had lengths greater than 80 cm in 1998 (47.7%) and 2000 (40.4%). By comparison corresponding values are only 13.7% for 1999 and 10.3% for 1997.

Figures 5a to 5c present age composition of the 2000 sampled cod. Figure 5a presents length versus age distribution. The mean sampled length was 70 cm. Mean lengths for 1997 to 1999 were 63.5, 68.8, and 63.9 cm respectively. The maximum lengths sampled for years 1997 through 2000 were 103, 118, 108, and 116 cm. The mean sampled age for 2000 was 6.6 years. Mean ages for 1997 to 1999 were 5.8, 6.4, and 6.1 years respectively. The maximum ages sampled for years 1997 through 2000 were 12, 15, 13, and 14 respectively. In 1997, cod of ages 15 on the St. Pierre Bank and 17 on the Burgeo Bank were sampled; however, these were from a grid survey in that year and not part of the stratified random survey.

Figures 5b and 5c present bar charts of the sampled numbers and percent occurrence of cod at age, including the 1997-1999 results. A total of 678 otoliths were taken, a comparable number to the 502 in 1997, 450 in 1998, and 551 in 1999. The oldest cod were three of age 14, all from the large sets: two from set 10 (a female of length 95 cm and a male of length 116 cm) and one from set 46 (a female of length 103 cm). In addition, there were two samples of age 13, 12 of age 12, and 100 of age 11.

Figure 5a.1 shows the percent occurrence of cod sampled at each age from the four years. The low representation of the weak 1991 year class is evident in all four years. 2000 indicates the largest proportion of age 3 and ages 10 and 11 of the four years. Conversely, compared to the other years, 2000 does in general show the smallest proportion of fish aged 4 through 9.

The age 3 otoliths present in the 678 samples for 2000 were generally well-distributed across the survey sets and the survey area. That is this was not an occurrence simply seen in several sets. While no age 3 fish were reported in the samples for the three largest sets, 9 of the 62 samples for set 44, the fourth largest set, and immediately adjacent to the largest set 45, were age 3.

Stratified Random surveys analysis was carried out using the DFO stratified analysis STRAP software and applying the French Exclusion Zone around St. Pierre et Miquelon for area calculations. As was the case for 1997 to 1999, a wingspread of 60 feet was used. Table 2a presents the STRAP output of estimated abundance and biomass. The estimated total number of cod for 3Ps is 37.7 million (with 75% confidence limits of 13.7 and 61.8 million). The mean number of cod per standard 1.5 nautical mile tow is 45.3 (with limits of 16.4 and 74.2 fish). The estimated total cod biomass is 187 ktonnes (with limits of 50 and 324 ktonnes). The mean catch weight per tow is 225 kg (with limits of 60 and 390 kg).

Table 3a presents the STRAP age composition of numbers per tow, with sexes combined. The total mean number per tow is 45.3 (consistent with the value in Table 2a, smaller than the mean of 71.9 in Table 1), with the greatest numbers expected at ages 3 (7.15 fish per tow), 11 (5.12 fish), and 6, 7, and 10 (5.23, 5.86, and 5.78 fish respectively). Table 3b presents a comparison of the estimated abundances and mean number of fish per tow for 1997-2000. The abundances are the greatest for the 1997 and 1989 year classes at 5.95 and 5.92 million cod. These values are generally comparable to those for the largest year classes 1989, 1990, 1993, and 1992 estimated from the 1997 survey which range from 7.05 to 5.55 million cod.

Tables 4a and 4b present the cod abundance and biomass estimates by strata for 1997 to 2000, arranged by depth regime. Consistent with the overall catch results and estimates, the 2000 values are all up significantly from those of 1998 and

1999, in each of the six depth ranges reported and in most of the individual strata. While the 2000 values are generally one half those for 1997 in the 51-100 fathom depth range, in the other ranges, the 2000 values are generally two to three times larger than for 1997.

Figures 6a and 6b present the STRAP-estimated mean numbers per tow and percent occurrence of mean catch numbers per tow. The mean number of fish per tow are the greatest for ages 3, 11, 10, 6, and 7. The numbers of age 4, 5, and 8 fish are comparable to those for 1998 and 1999, but noticeably less than the 1997 values. Age 9 fish generally have the same representation in all four years at slightly over one fish, while the 1998 value is slightly above three fish. Figure 6b shows that the percent occurrence of age 2, 3, 10, and 11 cod are all increased in 2000 from previous years. The percentage of ages 4 through 9 are all down somewhat from the previous years.

Figures 7a and 7b present age composition by year class as opposed to age. In 1997, the strongest year classes were 1992, 1989, and 1990 and 1993. In 1998, the strongest year classes were 1989, 1993, and 1994, 1992, and 1990 . In 1999, the strongest year classes were 1993, 1992, and 1994. In 2000, the 1997, 1989, 1990, 1993, and 1994 year classes are all relatively strong. The 1991 year class is weak in all years. For the year classes 1989, 1990, and 1993, the estimated numbers for 2000 are all well above those for 1998 and 1999 and on the order of half those for 1997.

Figure 8a presents the total estimated cod abundance for each of the four survey years 1997 to 2000. Figures 8b to 8d present the estimated abundances by year class for year classes 1986 to 1997. Note the different abundance scales used in the graphs. The year classes are arbitrarily grouped together, taking those in succession and with similar magnitudes of abundance. These figures illustrate that while abundance estimates were generally down quite noticeably in both 1998 and 1999 from 1997, there is both an increasing trend from 1998 to 1999 to 2000, and the values in 2000 are in most cases back up to levels comparable to 1997. And, for the more recent year classes (1994 to 1997 in Figure 8d), the 2000 estimates are significantly large and comparable to, or in some instances larger than, some of the strong year classes witnessed in the 1997 survey.

Figure 9 presents the STRAP-estimated abundance at length values for both sexes for all four survey years. For males, in 1997, the length distribution peak is the largest and most well-defined, and is centred between 58-73 cm. In 1998, the main distribution peak is greatly reduced, but centred about 60 cm as per 1997. A smaller secondary peak is evident near 85-90 cm. In 1999, the overall magnitude of the distribution is comparable to 1998 (6.2M males in 1999 compared with 4.8M males in 1998), and the distribution shape is similar, although there is a shift in the peak from 64 to 70 cm. In 2000, as already noted the abundance estimates are back up to 17M males compared with 15.5M males in 1997, and the length

distribution now shows two peaks: one at 70-76 cm and extending to 1 m; and a second at 46 cm.

In the lower panel of Figure 9 the evolution of the length distribution for females is similarly portrayed. While there are some differences in the shapes and magnitudes and peak locations in the curves, the general trend from 1997 through to 2000 is the same as for males.

Figure 10 presents the STRAP-estimated abundance at length values for all sexes combined for the four survey years 1997-2000. This also illustrates what appears to be a trend in increasing numbers of larger fish that was evident in Figure 9. While from 1997 to 1998 the data do indicate a "bottoming out" of sorts, there is a visible increase in the length distribution peak from 1998 to 1999 to 2000, a consistent increase of approximately 6 cm each year from 61 cm in 1998 to 67 cm in 1999 to 73 cm in 2000. Added to this growth is the new presence of a secondary peak located at 46 cm.

The results indicate that the 1997 year class stands out strong uniquely in 2000. The 1989 and 1990 year classes continue to be well-represented. The 1997 and 1989 year classes each account for 15% of the population estimates. While still relatively strong as proportions of the 2000 estimates, the percentages of the total population estimate of 1992, 1993, and 1994 year classes are all down about 5-10% from the previous three years. The 2000 length composition shows an increase in mean length of 2-6% from the previous three years. Of the sampled cod, there is a general shift to larger lengths with two general peaks in the distribution now evident, one in the 40-60 cm range corresponding to age 3 to 5 fish, and one in the 65-95 cm range corresponding to mostly age 8-11 fish.

Total abundance estimates for the 2000 survey are up three-fold from 1998 and 1999 and comparable to those for 1997. Total biomass estimates for 2000 are up almost four-fold from 1998 and 1999 and are almost double those of 1997.

The author would like to thank Barry McCallum of DFO for assistance in review of the SCANMAR data.

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Table 1 Summary of Cod Catches for Stratified Random Survey Sets, NAFO Division 3Ps, 4-15 Dec 2000.

M.V. Pennysmart Vessel	Trip	Set	Year	Month	Day	StrLin	Division	Unit Area	Set Location Lat (N)	Set Location Long (W)	COD Catch # of Fish	COD Catch Weight (kg)	Set Duration (min)	Tow Distance (n.mi.)	COD Mean Weight (kg)
49	5	1	0	12	4	322	3P	M29	46.56	55.71	4	2.0	30	1.5	0.5
49	5	2	0	12	4	322	3P	M29	46.52	55.59	1	1.2	30	1.5	1.2
49	5	3	0	12	5	322	3P	M30	46.47	55.64	0	0.0	30	1.5	
49	5	4	0	12	5	322	3P	M30	46.44	55.87	1	2.0	30	1.5	2.0
49	5	5	0	12	5	322	3P	L30	46.40	56.07	1	3.5	30	1.5	3.5
49	5	6	0	12	5	314	3P	L30	46.29	56.46	1	1.0	30	1.5	1.0
49	5	7	0	12	5	314	3P	L30	46.12	56.42	3	8.5	30	1.5	2.8
49	5	8	0	12	5	320	3P	L30	46.08	56.67	177	169.0	30	1.5	1.0
49	5	9	0	12	5	314	3P	L30	46.12	56.70	21	60.5	30	1.5	2.9
49	5	10	0	12	5	314	3P	L30	46.25	56.65	416	5007.2	30	1.5	12.0
49	5	11	0	12	5	314	3P	L29	46.62	56.93	7	2.5	30	1.6	0.4
49	5	13	0	12	5	311	3P	K29	46.83	57.15	2	3.0	30	1.5	1.5
49	5	14	0	12	6	310	3P	K29	46.88	57.13	34	43.5	30	1.5	1.3
49	5	15	0	12	6	310	3P	K29	46.85	57.29	63	181.0	30	1.5	2.9
49	5	16	0	12	6	313	3P	K29	46.70	57.38	42	97.0	30	1.5	2.3
49	5	17	0	12	6	312	3P	K29	46.63	57.31	59	123.0	30	1.5	2.1
49	5	18	0	12	6	713	3P	J29	46.56	58.72	0	0.0	30	1.5	
49	5	19	0	12	6	713	3P	K30	46.45	57.69	0	0.0	30	1.4	
49	5	20	0	12	6	713	3P	J30	46.33	58.04	0	0.0	30	1.4	
49	5	21	0	12	6	713	3P	K30	46.26	57.70	0	0.0	30	1.5	
49	5	22	0	12	6	311	3P	K30	46.44	57.35	0	0.0	30	1.5	
49	5	23	0	12	6	313	3P	K30	46.39	57.37	1	4.0	30	1.5	4.0
49	5	24	0	12	7	312	3P	K30	46.33	57.22	9	15.0	30	1.5	1.7
49	5	25	0	12	7	705	3P	K30	46.25	57.34	0	0.0	30	1.4	
49	5	26	0	12	7	705	3P	K30	46.21	57.38	0	0.0	30	1.4	
49	5	27	0	12	7	713	3P	K30	46.09	57.47	0	0.0	30	1.5	
49	5	28	0	12	7	712	3P	K31	45.85	57.54	0	0.0	30	1.5	
49	5	29	0	12	7	712	3P	K31	45.74	57.46	0	0.0	30	1.5	

49	5	30	0	12	7	712 3P	K31	45.73	57.11	0	0.0	30	1.5	
49	5	31	0	12	7	706 3P	L31	45.87	56.96	0	0.0	30	1.5	
49	5	32	0	12	7	316 3P	L31	45.72	56.72	10	28.0	30	1.5	2.8
49	5	34	0	12	7	320 3P	L31	45.86	56.55	6	16.0	30	1.5	2.7
49	5	35	0	12	8	706 3P	L31	45.56	56.64	2	4.5	30	1.5	2.3
49	5	36	0	12	8	706 3P	L31	45.51	56.65	0	0.0	30	1.6	
49	5	37	0	12	8	320 3P	L32	45.38	56.05	3	20.0	30	1.5	6.7
49	5	38	0	12	8	320 3P	M31	45.51	55.93	5	15.0	30	1.5	3.0
49	5	39	0	12	9	318 3P	N32	45.09	54.60	0	0.0	30	1.5	
49	5	40	0	12	9	319 3P	N32	45.11	54.87	21	116.0	30	1.5	5.5
49	5	41	0	12	9	319 3P	N32	45.15	55.00	50	152.0	30	1.6	3.0
49	5	42	0	12	9	319 3P	M32	45.25	55.19	14	50.5	30	1.6	3.6
49	5	43	0	12	9	319 3P	M32	45.32	55.37	4	8.5	30	1.4	2.1
49	5	44	0	12	9	319 3P	M32	45.18	55.38	692	1276.3	30	1.4	1.8
49	5	45	0	12	11	318 3P	M32	45.08	55.44	3071	17083.3	30	1.6	5.6
49	5	46	0	12	11	707 3P	M33	44.99	55.31	129	380.5	30	1.4	2.9
49	5	47	0	12	11	708 3P	M33	44.95	55.51	3	9.0	30	1.5	3.0
49	5	48	0	12	11	708 3P	M33	44.89	55.62	3	14.0	30	1.6	4.7
49	5	49	0	12	11	707 3P	M33	44.89	55.68	0	0.0	30	1.5	
49	5	50	0	12	11	317 3P	M32	45.01	55.99	0	0.0	30	1.5	
49	5	51	0	12	12	317 3P	L33	44.97	56.06	85	103.0	30	1.5	1.2
49	5	52	0	12	12	316 3P	L33	44.98	56.14	11	28.0	30	1.5	2.5
49	5	53	0	12	12	315 3P	L32	45.12	56.05	0	0.0	30	1.5	
49	5	54	0	12	12	315 3P	M32	45.10	55.88	0	0.0	30	1.5	
49	5	55	0	12	12	315 3P	M32	45.19	55.77	64	239.0	30	1.5	3.7
49	5	56	0	12	12	315 3P	M32	45.37	55.62	201	1570.9	30	1.6	7.8
49	5	57	0	12	12	320 3P	M31	45.60	55.80	7	47.0	30	1.5	6.7
49	5	58	0	12	12	320 3P	M31	45.61	55.65	9	94.0	30	1.5	10.4
49	5	59	0	12	13	321 3P	M30	46.15	55.88	0	0.0	30	1.4	
49	5	60	0	12	13	321 3P	M30	46.10	55.75	1	2.0	30	1.5	2.0
49	5	61	0	12	14	323 3P	L31	45.83	56.38	0	0.0	30	1.6	
49	5	62	0	12	14	323 3P	M31	45.65	55.07	0	0.0	30	1.5	
49	5	63	0	12	14	325 3P	M31	45.63	54.77	0	0.0	30	1.6	

49	5	64	0	12	14	326	3P	N31	45.60	54.42	1	1.5	30	1.6	1.5
49	5	65	0	12	14	326	3P	N31	45.63	54.42	0	0.0	30	1.6	
49	5	66	0	12	14	325	3P	N31	45.75	54.70	1	0.5	30	1.5	0.5
49	5	67	0	12	14	325	3P	N31	45.78	54.90	0	0.0	30	1.5	
49	5	68	0	12	14	325	3P	N31	45.92	54.77	0	0.0	30	1.5	
49	5	69	0	12	14	323	3P	M30	46.09	55.28	0	0.0	30	1.6	
49	5	70	0	12	14	324	3P	N30	46.23	54.87	1	0.7	30	1.6	0.7
49	5	71	0	12	14	324	3P	N30	46.47	54.61	7	3.5	30	1.6	0.5
49	5	72	0	12	15	322	3P	M30	46.27	55.35	0	0.0	30	1.5	
49	5	73	0	12	15	321	3P	M30	46.22	55.77	2	1.5	30	1.5	0.8
49	5	74	0	12	15	321	3P	M30	46.09	55.50	1	1.5	30	1.5	1.5
49	5	75	0	12	15	321	3P	M31	45.99	55.63	1	1.0	30	1.6	1.0

Minimum	0.0	0.0	30.0	1.4	0.4
Maximum	3071.00	17083.32	30.00	1.60	12.04
Mean	71.88	369.75	30.00	1.51	2.97
Median	1.00	2.00	30.00	1.50	2.31
Standard Error	5.06	28.49	0.00	0.00	0.03
Total	5247.00	26991.57	2190.00	110.20	133.59
Count	73	73	73	73	73

Table 2a Stratified Analysis Estimated Cod Abundance and Biomass

COD GEAC 3PS 2000 No Zone
ANALYSIS FOR TRIP 5 2000 VESSEL 49 ICNAF 3P SPECIES 0438

NUMBERS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	97.00	48.50	9255.	448888.	420.50
311	2	2.00	1.00	17903.	17903.	2.00
312	2	68.00	34.00	16281.	553568.	1250.00
313	2	43.00	21.50	11147.	239661.	840.50
314	5	447.56	89.51	61748.	5527201.	33371.91
315	4	252.44	63.11	52357.	3304235.	7891.17
316	2	21.00	10.50	11147.	117044.	0.50
317	2	85.00	42.50	11620.	493847.	3612.50
318	2	2879.06	1439.53	8715.	12545447.	4144500.50
319	5	826.71	165.34	66477.	10991473.	103963.49
320	6	207.00	34.50	79988.	2759600.	4877.50
321	5	4.94	0.99	73503.	72584.	0.50
322	6	7.00	1.17	94648.	110423.	2.17
323	3	0.00	0.00	47020.	0.	0.00
324	2	7.50	3.75	33374.	125151.	15.82
325	4	1.00	0.25	63775.	15944.	0.25
326	2	0.94	0.47	11215.	5257.	0.44
705	2	0.00	0.00	13174.	0.	0.00
706	3	2.00	0.67	28509.	19006.	1.33
707	2	138.21	69.11	4999.	345486.	9551.59
708	2	5.81	2.91	8512.	24739.	0.02
712	3	0.00	0.00	49385.	0.	0.00
713	5	0.00	0.00	57492.	0.	0.00

TOTAL	TOTAL UPPER	TOTAL LOWER	AVERAGE MEAN	AVERAGE UPPER	AVERAGE LOWER
37717460.	61772288.	13662635.	45.32	74.22	16.42

EFFECTIVE DEGREES OF FREEDOM= 3 STUDENTS T-VALUE= 1.42 ALPHA=0.25

WEIGHTS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	224.50	112.25	9255.	1038920.	9453.13
311	2	3.00	1.50	17903.	26854.	4.50
312	2	138.00	69.00	16281.	1123418.	5832.00
313	2	101.00	50.50	11147.	562925.	4324.50
314	5	5079.53	1015.91	61748.	62730016.	4978839.50
315	4	1711.71	427.93	52357.	22405110.	497835.53
316	2	56.00	28.00	11147.	312117.	0.00
317	2	103.00	51.50	11620.	598427.	5304.50
318	2	16015.59	8007.80	8715.	69787576.	-
319	5	1682.46	336.49	66477.	22368904.	335007.44
320	6	361.00	60.17	79988.	4812636.	3753.37
321	5	5.94	1.19	73503.	87285.	0.58
322	6	8.70	1.45	94648.	137240.	1.82
323	3	0.00	0.00	47020.	0.	0.00
324	2	3.94	1.97	33374.	65704.	3.45
325	4	0.50	0.13	63775.	7972.	0.06
326	2	1.41	0.70	11215.	7885.	0.99
705	2	0.00	0.00	13174.	0.	0.00
706	3	4.50	1.50	28509.	42764.	6.75
707	2	407.63	203.81	4999.	1018915.	83079.07
708	2	22.13	11.06	8512.	94167.	8.51
712	3	0.00	0.00	49385.	0.	0.00
713	5	0.00	0.00	57492.	0.	0.00

TOTAL	TOTAL UPPER	TOTAL LOWER	AVERAGE MEAN	AVERAGE UPPER	AVERAGE LOWER
187228848.	324494496.	49963204.	224.97	389.90	60.03

EFFECTIVE DEGREES OF FREEDOM= 3 STUDENTS T-VALUE= 1.42 ALPHA=0.25

Table 2b Stratified Analysis Estimated Cod Abundance and Biomass: Comparison for 1997-2000

3Ps Cod Estimates						
"numbers"abundance (millions of fish)						
	95% upper limit	Estimated	95% lower limit	95% upper limit	Mean #fish /tow	95% lower limit
1997	57.1	30.9	4.8	97	52.6	8.2
1998 **	11.9	10.5	9.1	14	12.6	11
1999	20.7	13.7	6.7	24.9	16.5	8.1
2000 **	61.7	37.7	13.6	74.2	45.3	16.4
"weights" biomass (ktonnes)						
	95% upper limit	estimated	95% lower limit	95% upper limit	Mean catch /tow (kg)	95% lower limit
1997	174.2	99.3	24.4	296	169	41
1998 **	56.8	47.9	38.9	68.3	57.5	46.8
1999	61.7	44.5	27.3	74.1	53.5	32.9
2000 **	324.5	187.2	50.0	389.9	225.0	60.0
** 75% upper and lower limits reported for 1998 and 2000						

Table 3a Stratified Analysis Cod Age Composition, Numbers per Standard Tow

COD GEAC 2000 3PS No Zone (S1 BY AGE)
ANALYSIS FOR TRIP 5 2000
VESSEL 49
ICNAF 3P

AGE COMPOSITION-NUMBERS PER STANDARD TOW

SUMMARY TABLE
SPECIES:SPECIES 0438
SEX:COMBINED

AGE IN YEARS	TOTAL NUMBERS	UPPER LIMIT	LOWER LIMIT	MEAN PER TOW	UPPER LIMIT	LOWER LIMIT	D.F.
0.0	0.	0.	0.	0.00	0.00	0.00	0
1.0	0.	0.	0.	0.00	0.00	0.00	0
2.0	1364179.	3927721.	-1199363.	1.64	4.72	-1.44	5
3.0	6025260.	14311040.	-2260521.	7.24	17.20	-2.72	5
4.0	2376121.	6600131.	-1847889.	2.86	7.93	-2.22	4
5.0	2786660.	7116314.	-1542993.	3.35	8.55	-1.85	5
6.0	4309477.	37930344.	-29311392.	5.18	45.58	-35.22	1
7.0	4898682.	43822968.	-34025608.	5.89	52.66	-40.88	1
8.0	3321455.	30792050.	-24149140.	3.99	37.00	-29.02	1
9.0	952870.	7030852.	-5125113.	1.14	8.45	-6.16	1
10.0	4853005.	16195102.	-6489094.	5.83	19.46	-7.80	2
11.0	5944197.	14613356.	-2724962.	7.14	17.56	-3.27	5
12.0	657632.	1597998.	-282734.	0.79	1.92	-0.34	5
13.0	88677.	278708.	-101354.	0.11	0.33	-0.12	4
14.0	141752.	352804.	-69299.	0.17	0.42	-0.08	5
UNKNOWN	0.	0.	0.	0.00	0.00	0.00	0
TOTAL	37719972.	91532560.	-16092613.	45.32	109.98	-19.34	3

ESTIMATION TYPE:STANDARD TRANSFORMATION TYPE:NONE
CONFIDENCE LEVEL: 0.95%
****-ONE OR MORE OF THE LOWER LIMITS IN THE ABOVE
TABLE IS LESS THAN OR EQUAL TO ZERO. VARIANCE IS TOO LARGE FOR VALID CONFIDENCE LIMITS ****

Table 3b Stratified Analysis Estimated Cod Abundance Year Class Distribution: Comparison for 1997-2000

	3Ps Cod Estimates							
	"number" abundance (millions of fish)				Mean #fish/tow			
Year Class	1997	1998	1999	2000	1997	1998	1999	2000
1997	0.00	0.00	0.28	5.95	0.00	0.00	0.34	7.15
1996	0.00	0.05	0.95	2.35	0.00	0.06	1.14	2.83
1995	0.17	0.33	1.43	2.78	0.29	0.40	1.71	3.34
1994	1.93	1.47	2.35	4.35	3.28	1.76	2.83	5.23
1993	5.55	1.93	2.98	4.88	9.42	2.32	3.58	5.86
1992	8.02	1.51	2.72	3.31	13.62	1.81	3.27	3.97
1991	1.78	0.29	0.43	0.95	3.02	0.35	0.51	1.14
1990	5.91	1.36	1.19	4.81	10.03	1.64	1.43	5.78
1989	7.05	2.83	1.13	5.92	11.97	3.40	1.36	7.12
1988	0.79	0.33	0.14	0.66	1.34	0.40	0.17	0.79
1987	0.32	0.04	0.08	0.09	0.54	0.04	0.10	0.11
1986	0.14	0.11	0.01	0.14	0.24	0.13	0.02	0.17

Table 4a Cod abundance estimates (thousands of fish) from GEAC surveys in NAFO Division 3Ps from 1997-2000

Depth range (fathoms)	Strata	Vessel Trip #Sets Mean Date sq. mi.	Pennysmart 2 84 12-Dec 1997	Pennysmart 3 86 6-Dec 1998	Pennysmart 4 90 27-Nov 1999	Pennysmart 5 73 10-Dec 2000
<30	314	974	86	1111	138	5527
	320	1320	4004	1540	1914	2760
		Subtotal	4090	2651	2052	8287
31-50	312	272	725	33	347	554
	315	827	2046	1456	3158	3304
	321	1189	175	189	250	73
	325	944	50	11	52	16
	326	166	17	0	5	5
		Subtotal	3013	1689	3812	3952
51-100	311	317	832	63	141	18
	317	193	226	331	126	494
	319	984	17410	370	833	10991
	322	1567	.	95	253	110
	323	696	225	47	18	0
	324	494	.	78	100	125
		Subtotal	18693	984	1471	11738
101-150	310	170	150	699	134	449
	313	165	443	167	1053	240
	316	189	3606	312	92	117
	318	129	339	3736	4959	12545
		Subtotal	4538	4914	6238	13351
151-200	705	195	103	7	0	0
	706	476	513	29	10	19
	707	74	29	180	137	345
		Subtotal	645	216	147	364
201-300	708	126	.	9	17	25
	712	731	.	0	0	0
	713	851	.	19	0	0
		Subtotal	0	28	17	25
	Total [1]		30,979	10,482	13,737	37,717

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.
. denotes strata not fished

Table 4b Cod biomass estimates (t) from GEAC surveys in NAFO Division 3Ps from 1997-2000

Depth range (fathoms)	Strata	Vessel Trip #Sets Mean Date sq. mi.	Pennysmart 2 84 12-Dec 1997	Pennysmart 3 86 6-Dec 1998	Pennysmart 4 90 27-Nov 1999	Pennysmart 5 73 10-Dec 2000
<30	314	974	262	7464	246	62730
	320	1320	18907	5287	5276	4813
		Subtotal	19169	12751	5522	67543
31-50	312	272	1215	138	775	1123
	315	827	11171	4071	10443	22405
	321	1189	301	559	962	87
	325	944	89	55	113	8
	326	166	36	0	2	8
		Subtotal	12812	4823	12295	23631
51-100	311	317	1558	120	286	27
	317	193	957	938	336	598
	319	984	48133	1255	2455	22369
	322	1567	.	149	345	137
	323	696	341	103	31	0
	324	494	.	174	78	66
		Subtotal	50989	2739	3531	23197
101-150	310	170	263	1823	322	1039
	313	165	1132	458	2469	563
	316	189	12362	803	292	312
	318	129	911	23797	19561	69788
		Subtotal	14668	26881	22644	71702
151-200	705	195	277	11	0	0
	706	476	1317	118	33	43
	707	74	96	480	466	1019
		Subtotal	1690	609	499	1062
201-300	708	126	.	16	29	94
	712	731	.	0	0	0
	713	851	.	57	0	0
		Subtotal	0	73	29	94
	Total [1]		99,328	47,876	44,520	187,229

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.
. denotes strata not fished

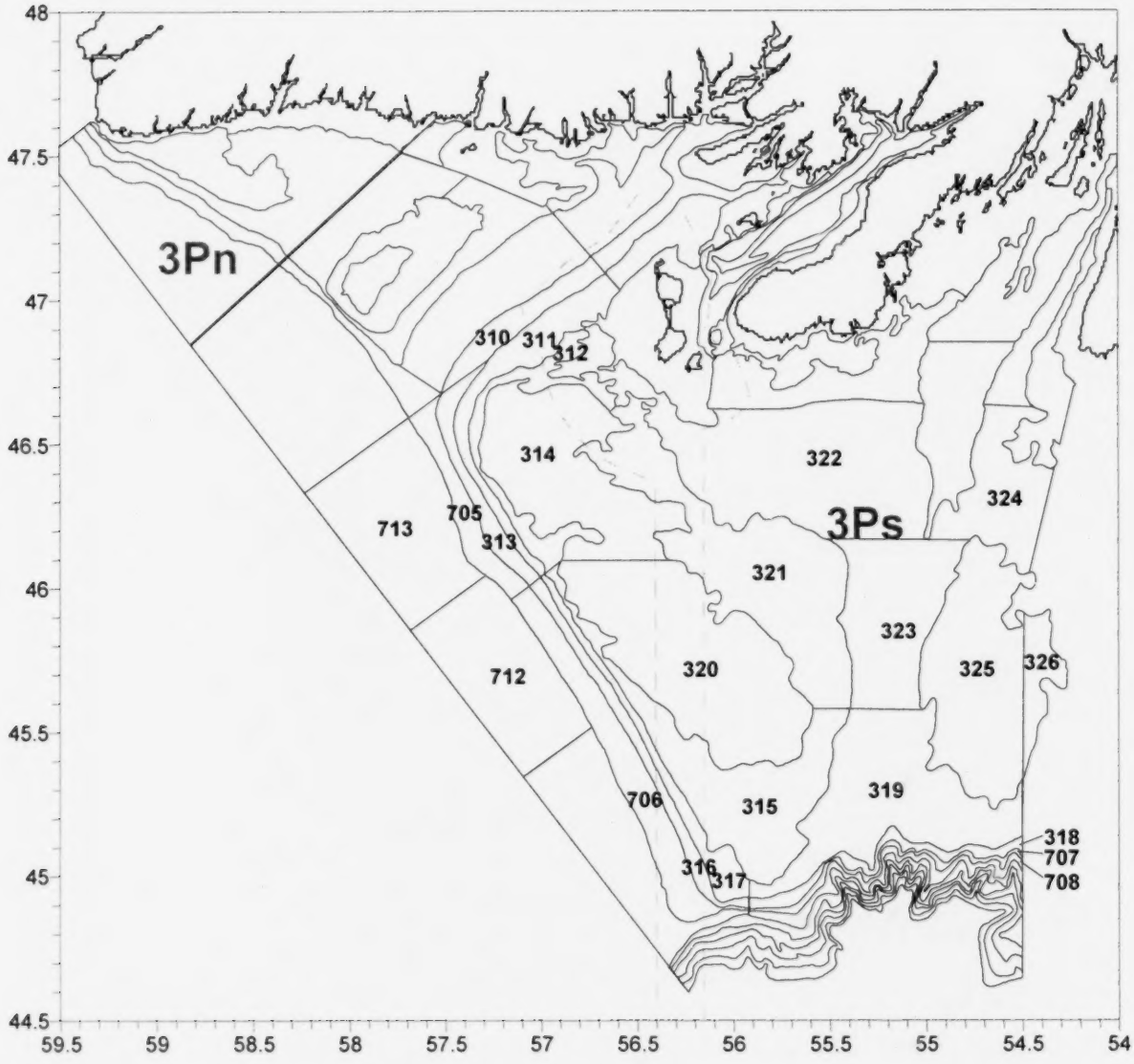


Figure 1 Stratum boundaries within NAFO Division 3P. Numbered strata indicate those surveyed during fall GEAC bottom trawl survey of Subdivision 3Ps. Dashed line is boundary of French economic zone which was not surveyed.

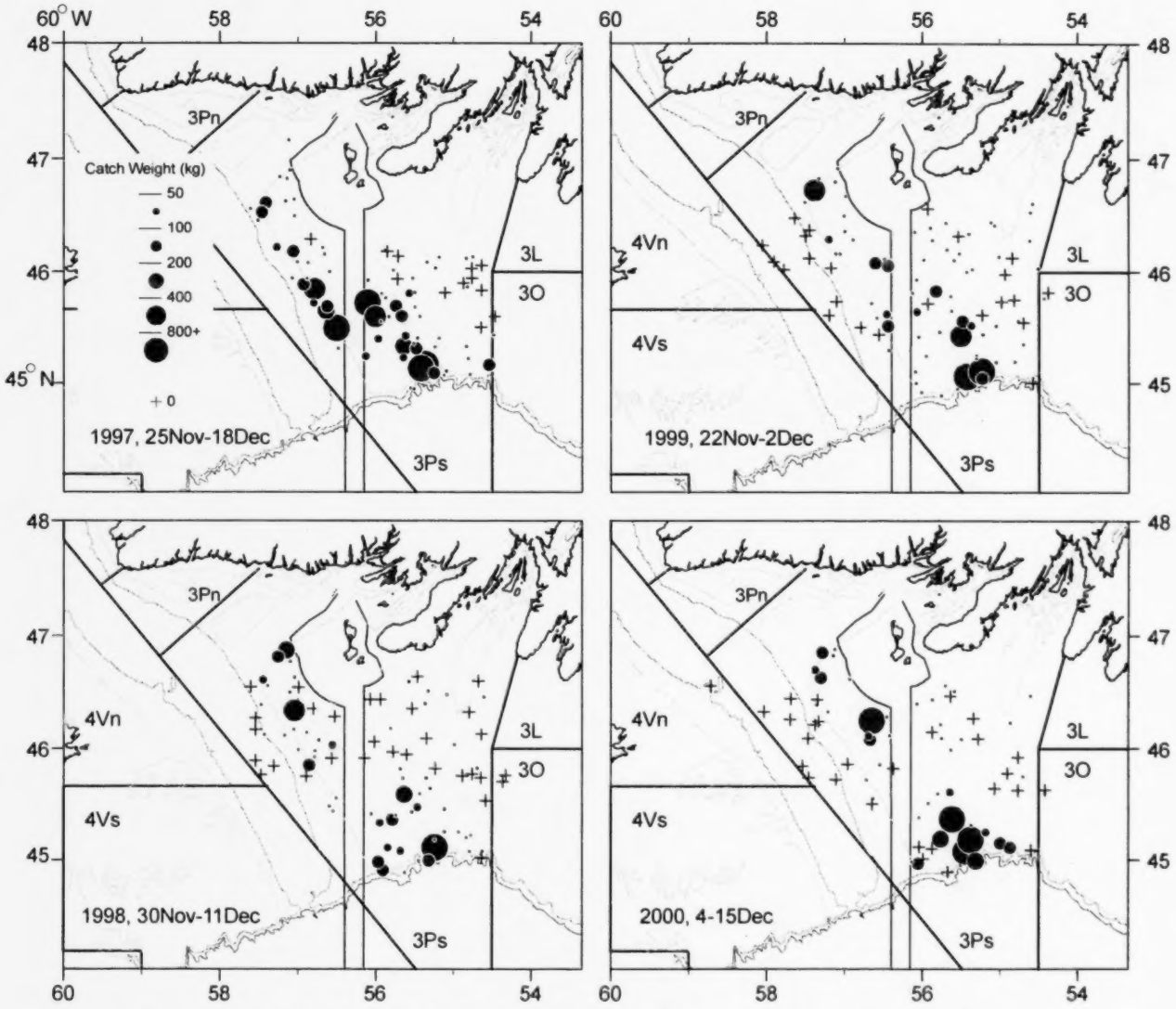


Figure 2 Cod Catch Weight Distribution from GEAC Stratified Random Surveys, 3Ps, 1997-2000. 200, 400, and 800 m depth contours are shown.

Figure 3 2000 3Ps Survey Net Parameters

Mean values D=72.0, O=5.4, C=0.6

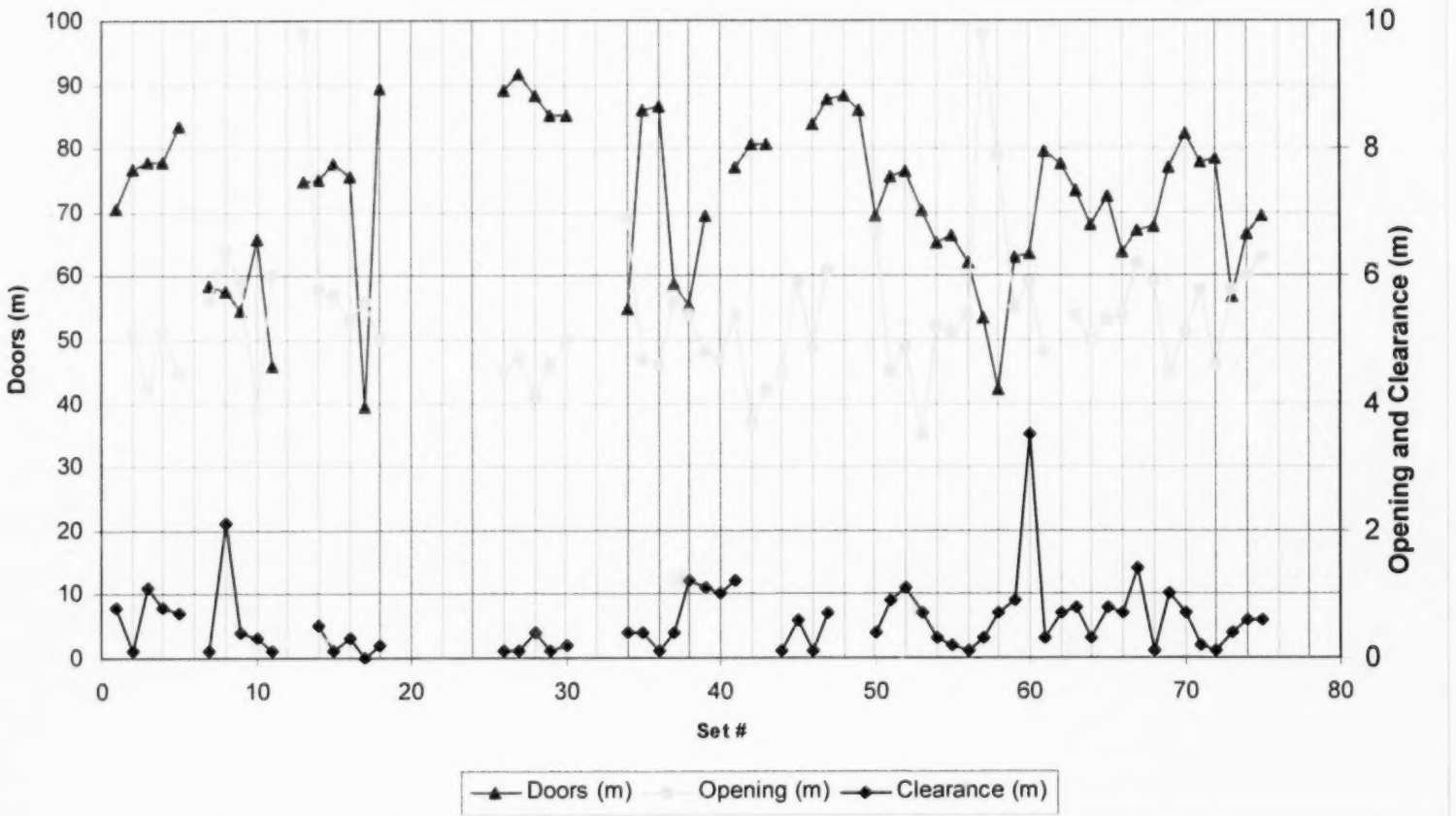


Figure 4 Length Composition of Cod
(3Ps Stratified Random Surveys 1997-2000)

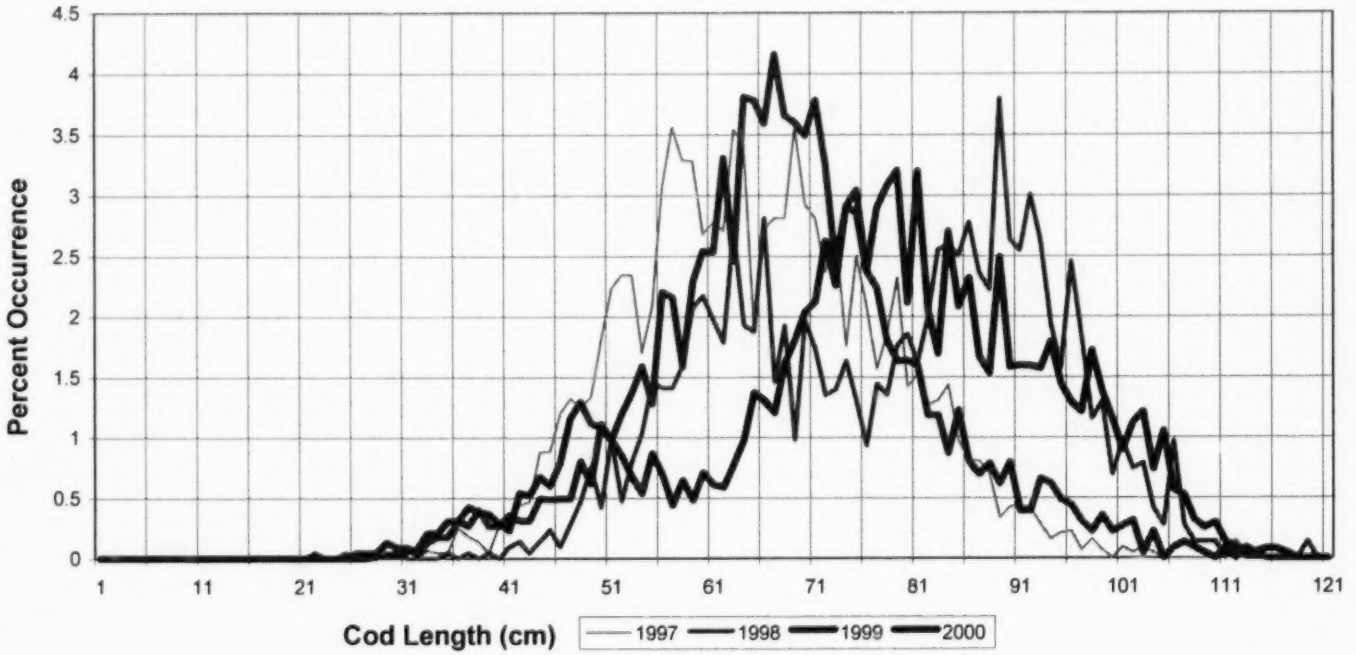


Figure 5a Cod Age-Length Composition
3Ps 2000 (678 samples)

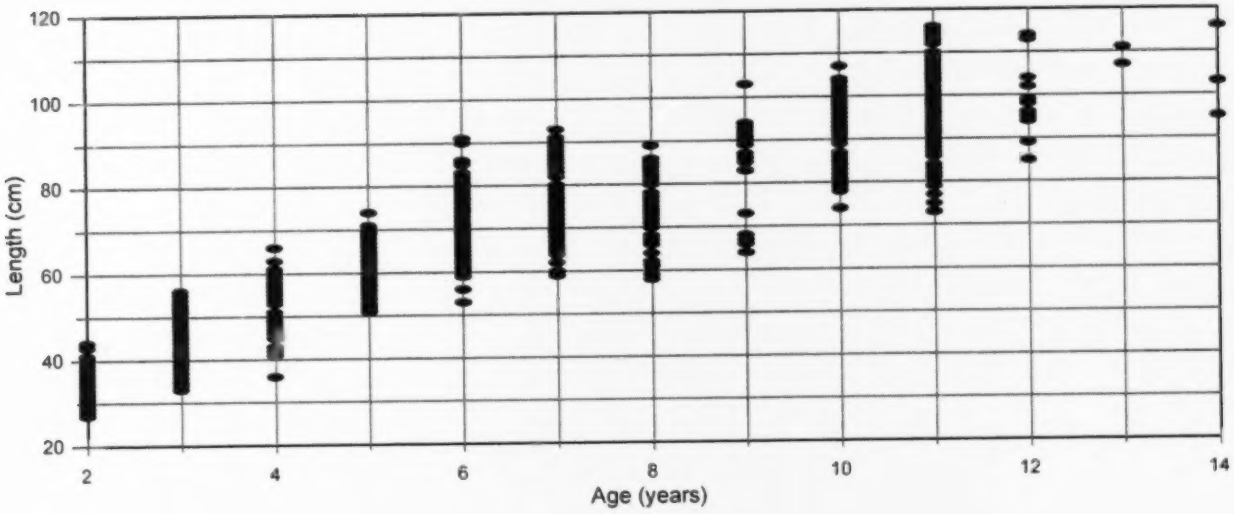


Figure 5a.1 Sampled Cod Age Distribution, 3Ps

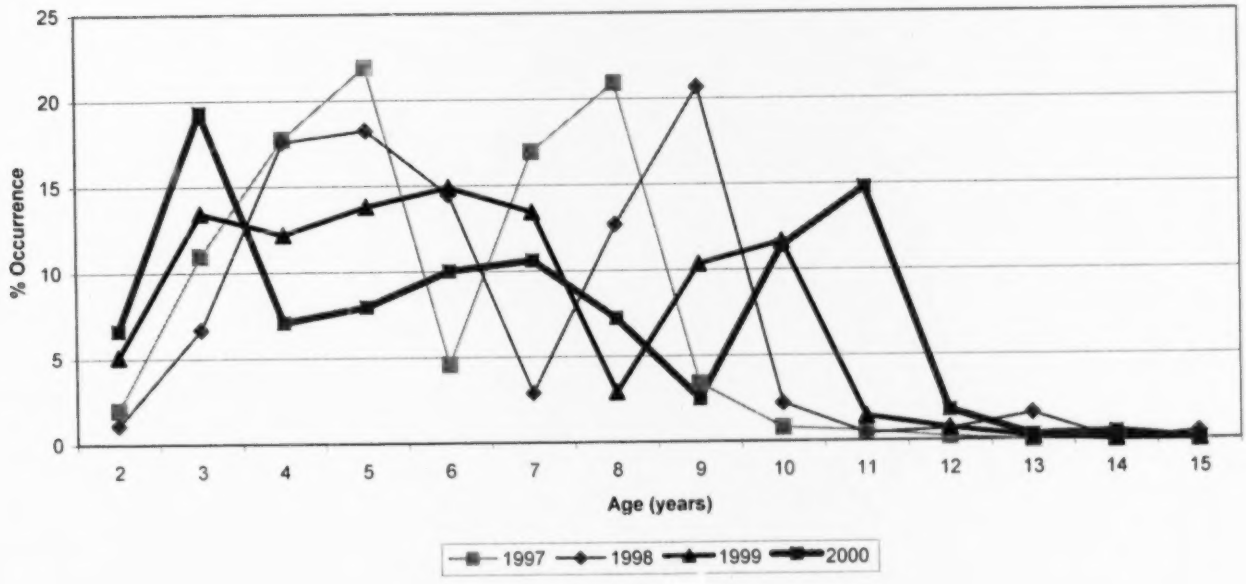


Figure 5b Age Composition of Cod
3Ps Sampled Cod

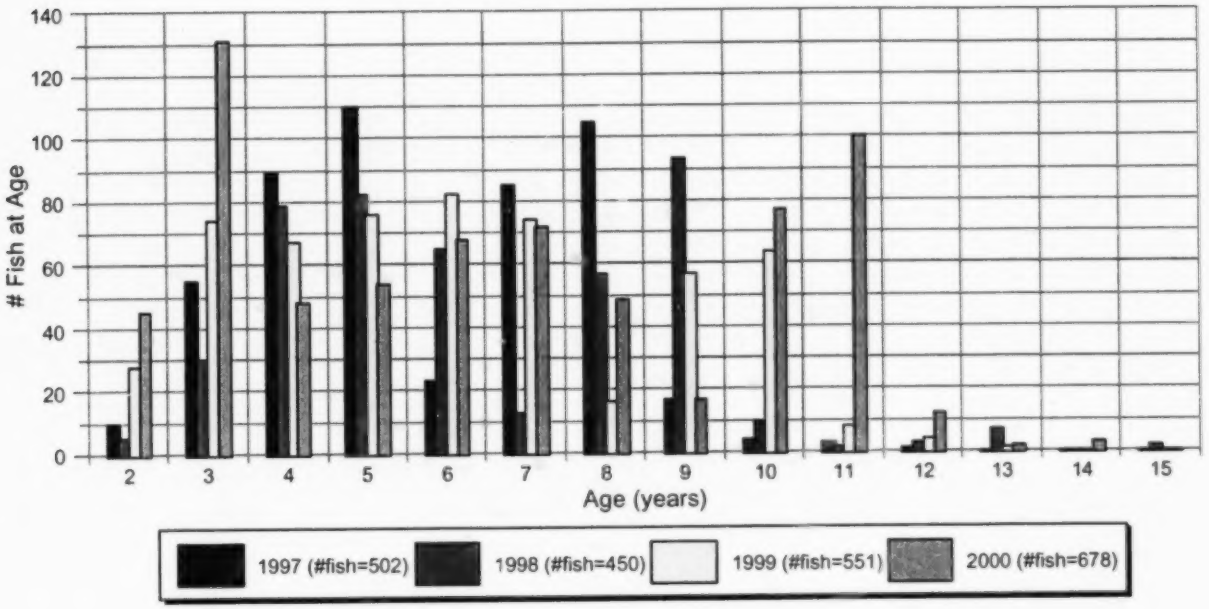


Figure 5c Age Composition of Cod
3Ps Sampled Cod

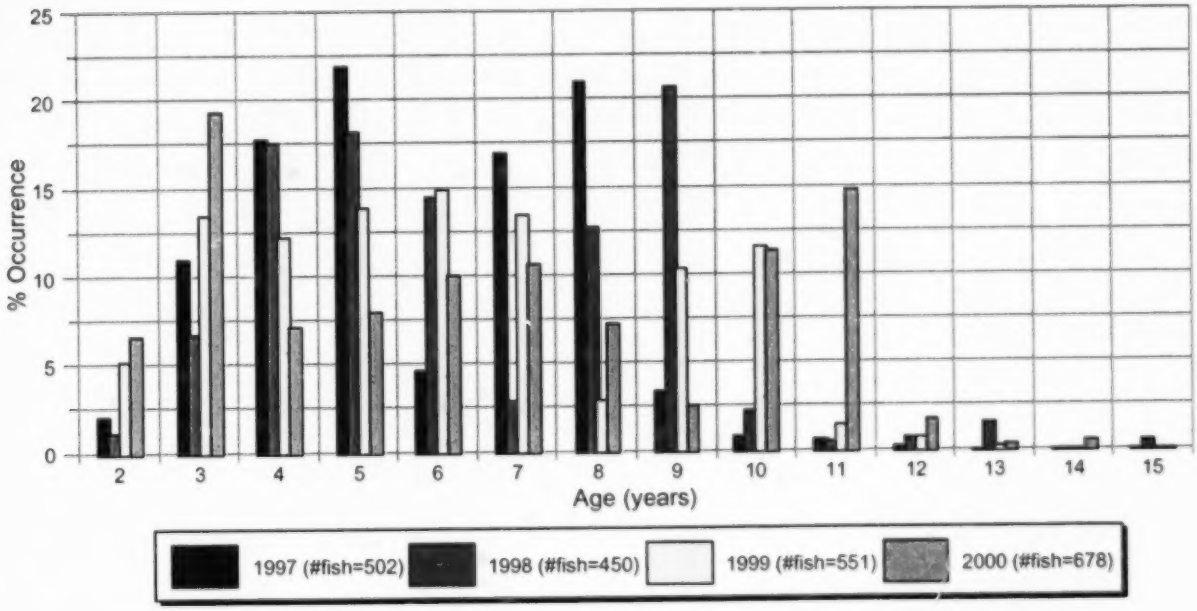


Figure 6a Age Composition of Cod, 3Ps
Estimated Mean #s per tow

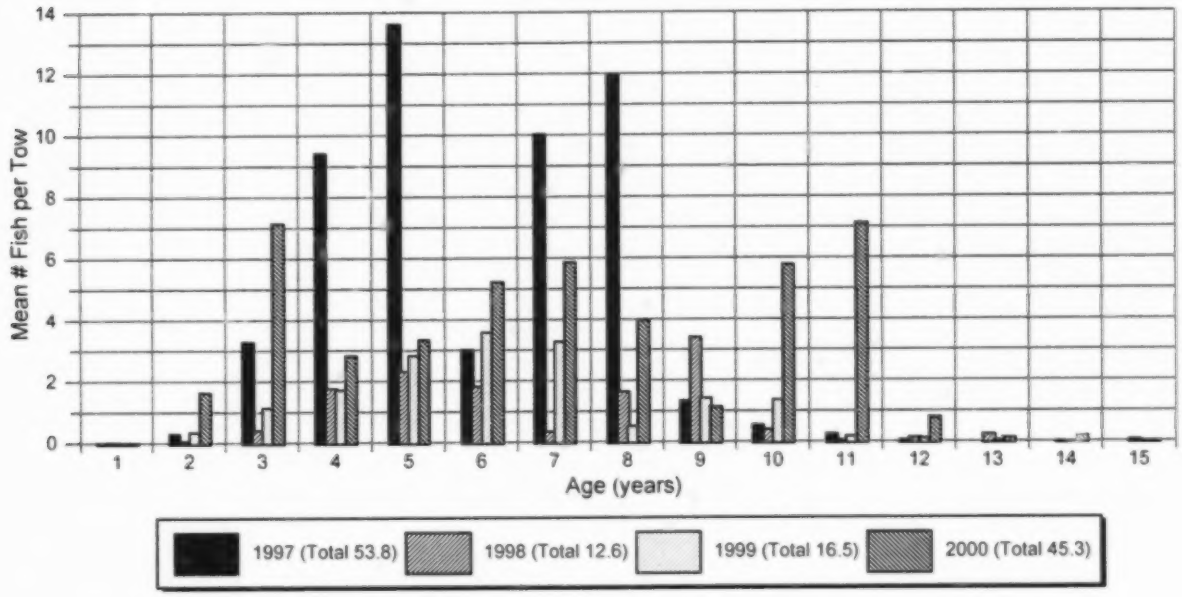
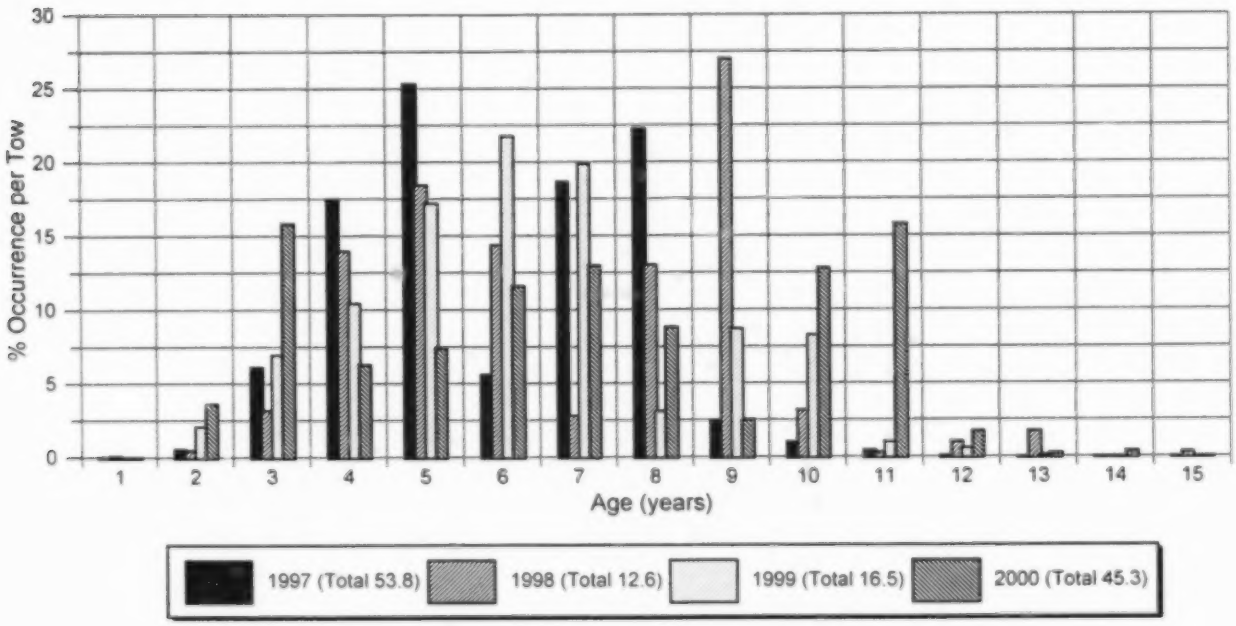


Figure 6b Age Composition of Cod, 3Ps
Estimated % of Total Mean #s per tow



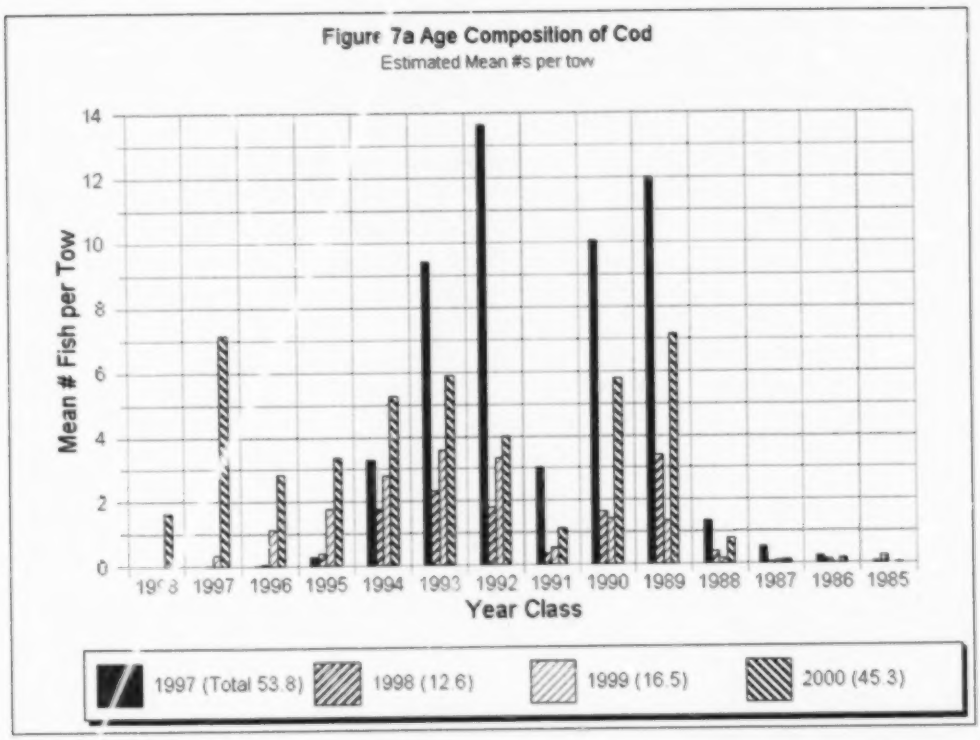


Figure 7a Age Composition of Cod
Estimated Mean #s per tow
Mean # Fish per Tow
0
2
4
6
8
10
12
14
1998 1997 1996 1995 1994 1993 1992 1991 1990 1989 1988 1987 1986 1985
Year Class
1997 (Total 53.8)
1998 (12.6)
1999 (16.5)
2000 (45.3)

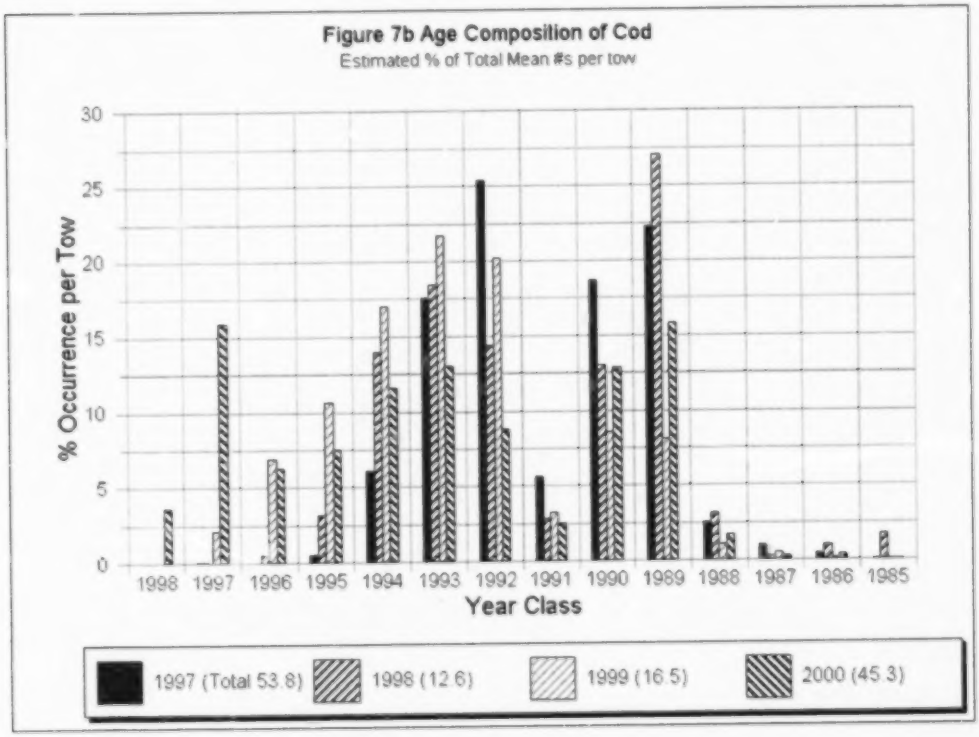


Figure 7b Age Composition of Cod
Estimated % of Total Mean #s per tow
% Occurrence per Tow
0
5
10
15
20
25
30
1998 1997 1996 1995 1994 1993 1992 1991 1990 1989 1988 1987 1986 1985
Year Class
1997 (Total 53.8)
1998 (12.6)
1999 (16.5)
2000 (45.3)

Figure 8a Estimated Cod Abundance, 3Ps, 1997-2000

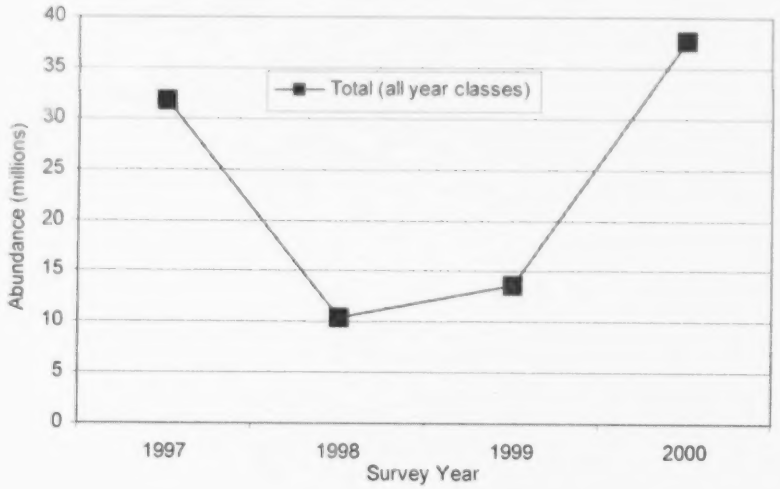


Figure 8b Estimated Cod Abundance, 3Ps, 1997-2000
1986, 1987, 1988 and 1991 year classes

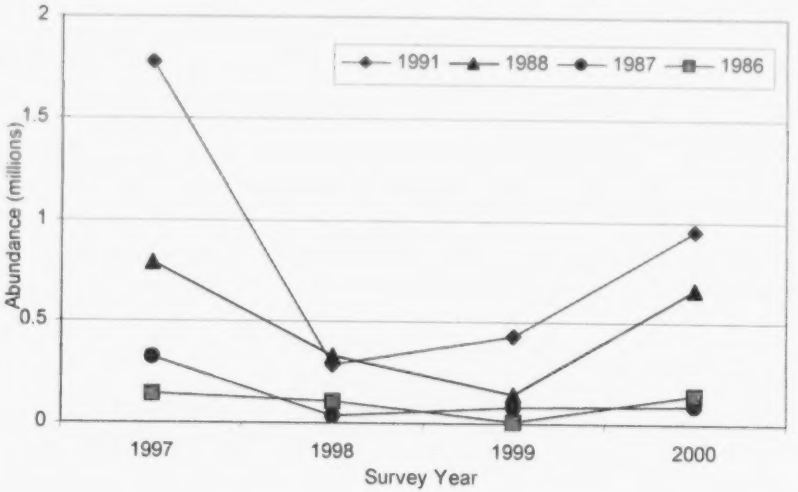


Figure 8c Estimated Cod Abundance, 3Ps, 1997-2000
1989, 1990, 1992 and 1993 year classes

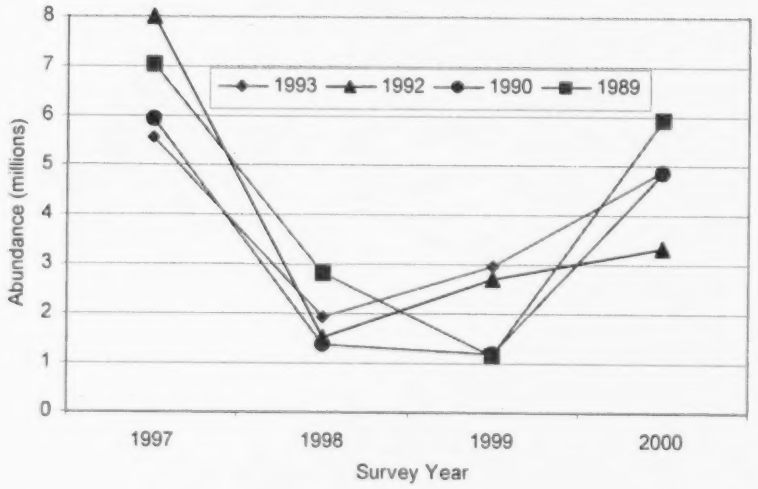
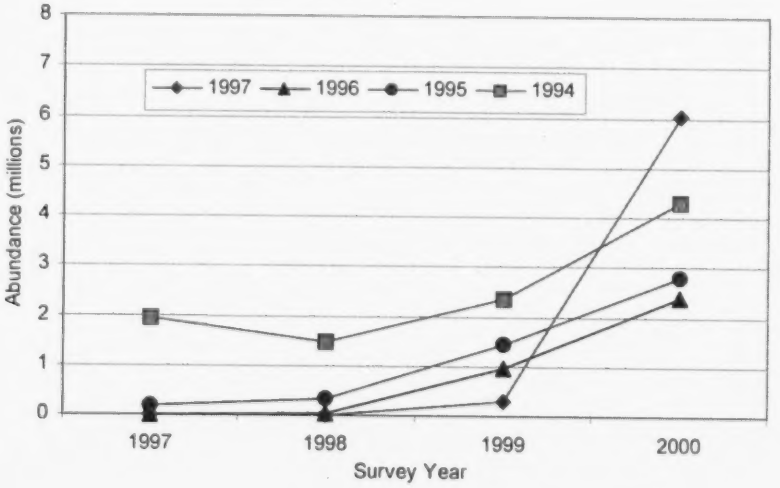


Figure 8d Estimated Cod Abundance, 3Ps, 1997-2000
1994 to 1997 year classes



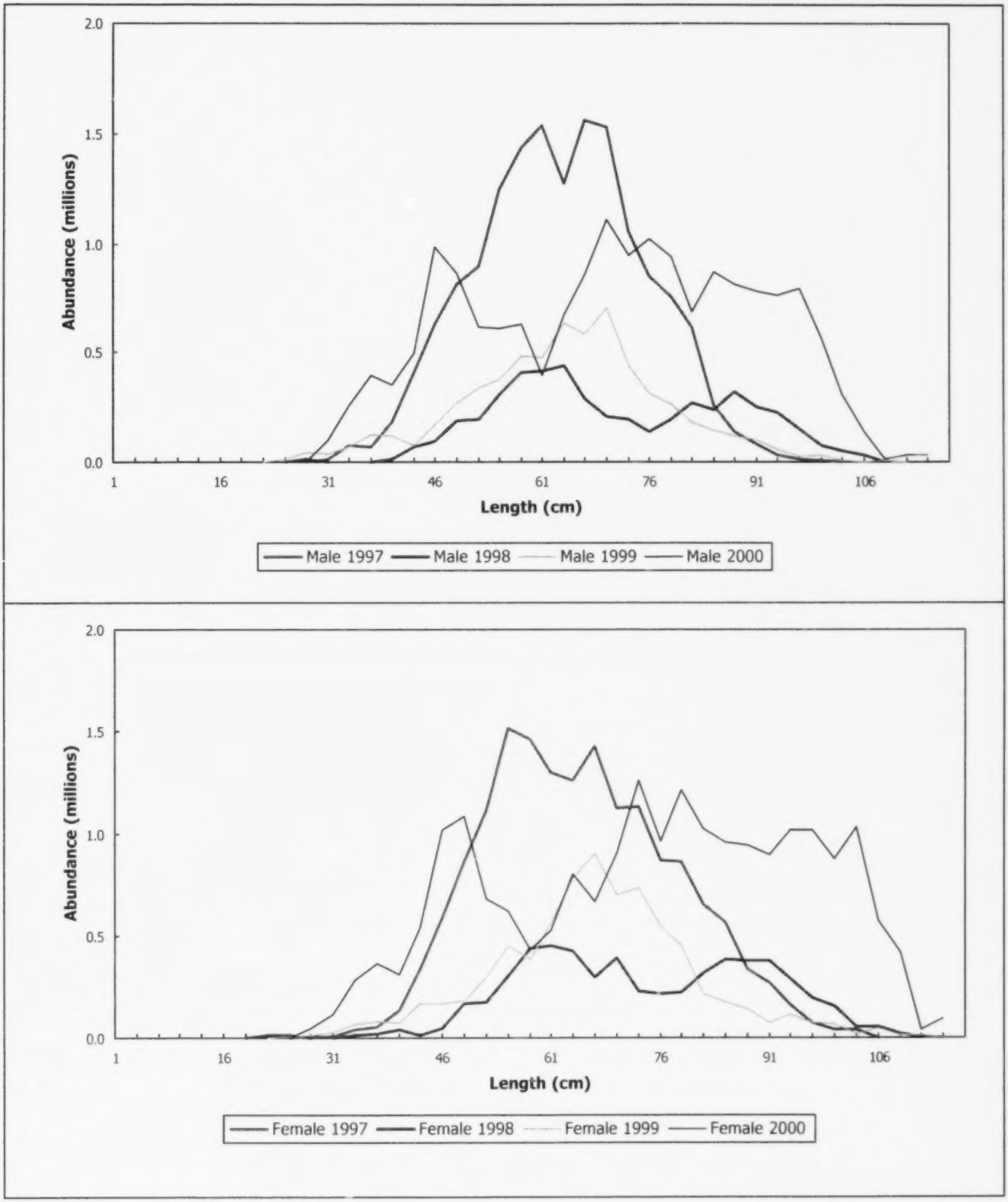


Figure 9 Cod survey abundance index at length from GEAC Industry surveys of 3Ps, 1997-2000. Distributions are shown for female populations.

Figure 10 Cod Survey Abundance index at length, 3Ps, 1997-200